

III.—*On the preparation of Opium for the China market: written in March 1835, and then communicated to the Benares and Behár Agencies. By D. BUTTER, M. D. Surgeon 63rd B. N. I. late opium examiner of the Benares Agency.*

1. In committing to paper, for the use of my successor in office, the following observations, I would beg, once for all, to disclaim the idea of their being infallibly correct: for, although they are the result of ten years' attention to their various subjects, I am aware of the disadvantages under which an individual labours, upon whom falls the task of first writing upon any subject involving the discussion of obscure questions, and who is thus deprived of the benefit of the judgment of other persons; and am prepared to find my remarks hereafter greatly modified by the progress of discovery.

2. The great object of the Bengal Opium Agencies is to furnish an article suitable to the peculiar tastes of the population of China, who value any sample of opium in direct proportion to the quantity of hot-drawn watery extract obtainable from it, and to the purity and strength of the flavour of that extract when dried and smoked through a pipe. The aim, therefore, of the agencies should be to prepare their opium so that it may retain as much as possible its native sensible qualities, and its solubility in hot-water. Upon these points depend the virtually higher price that Benares opium brings in the China market, and the lower prices of Behar, Malwa, and Turkey opium. Of the last of these, equal (Chinese) values contain larger quantities of the narcotic principles of opium; but are, from their greater spissitude, and the less careful preparation of the Behar and Malwa, incapable of yielding extract in equal quantity and perfection of flavour with the Benares.

3. It therefore becomes a question, how the whole process of the production of opium, from the sowing of the seed to the packing of the chests for sale, should be conducted so as to preserve with the least injury its native flavour and its solubility.

4. There can be no doubt that the quantity and richness of the milk obtained from each poppy-head depend greatly upon the geological and other physical conditions of the locality which produces it; especially the soil, sub-soil, manuring, and irrigation; and also upon the seed which is employed. But as these matters are, in the present circumstances of the Bengal agencies, little open to choice or control, the first *practical* enquiries which claim our attention relate to the extraction of the juice and its treatment while in the hands of the *koeris*.

5. Of the various processes for the preparation of sugar and medicinal extracts from vegetable juices, it is well known that distillation in

vacuo is incomparably the most efficient in preserving unaltered the original taste of the sugar, and the taste, solubility, and therapeutic powers of the extracts. It is also known that this process owes its superiority to the exclusion of the chemical as well as the physical agency of the atmosphere, to its rapidity of exsiccation, and to the comparative lowness of temperature at which it is performed. When sugar-cane juice, after even half an hour's exposure to the air, is boiled in a narrow deep vessel, and under the pressure of the atmosphere, vaporisation goes on so slowly that the sugar has time to undergo the vinous and acetous fermentations, whereby a certain portion of it is converted into vinegar, before the heat can be raised high enough to check this change; and the high temperature, to which it is so long exposed during this slow vaporisation, chars another portion, and converts it into molasses. Other vegetable juices, under similar circumstances, undergo analogous transformations: much of their substance is converted into vinegar; and the high temperature causes a partial decomposition of the rest: oxygen also is largely absorbed from the atmosphere, and greatly impairs the solubility of the dried extract.

6. On the principles which flow from these facts, it would be, *chemically* speaking, advisable to prepare opium by distilling in vacuo, large quantities of the milk just as it has oozed from the capsules; and I have no doubt that opium thus prepared would possess in an unprecedented degree the desired qualities of solubility and strength, and purity of flavour, as well as narcotic power; and can imagine, that under a system of open trade in opium, this process would be *commercially* profitable. It would, however, be inapplicable under a monopoly constituted as the present system is; and I have mentioned it only with the view of pointing it out as the acme of that perfection in the preparation of vegetable juices to which we can, with our present means, only approximate.

7. That the approximation may proceed as far as possible, it will be necessary, first, that the poppy juice shall at the time of collection, contain a minimum of water; so that its reduction to the proposed degree of spissitude may be effected in the shortest time, and be therefore attended with the least exposure to the air at a high temperature, and with the smallest consequent loss of solubility and of specific qualities that may be practicable.

8. The goodness of the soil, and the management of the irrigation, are circumstances which powerfully affect the strength of the juice at the time of its collection: but a third agent, still less amenable than these to control, now comes into play, the precipitation of *dew* on the

surface of the capsule. When a current of wind, or a cloudy sky, prevents the formation of dew, it is found that the scarifications made in the capsule about the middle of the preceding day are sealed up by the slight oozing of juice, which had immediately followed the incisions; and the quantity of opium obtained is small. When, again, the dew is abundant, it washes open the wounds in the capsule, and thus facilitates the flow of the milk, which in *heavy* dews is apt to drop off the capsule entirely, and be wasted. But when the dew is in moderate quantity, it allows the milk to thicken by evaporation, and to collect in irregular tiers, (averaging one grain of solid opium from each quadruple incision,) which on examination will be found to have a greater consistency, and a "rose-red" (*Werner*) colour towards the external surface, while the interior is semi-fluid, and of a "reddish-white" colour. This inequality of consistence constitutes the *grain of raw opium*, of which I shall have to speak hereafter.

9. In the collection of these drops of half-dried juice, it is very apt to get mixed with the dew, which, in the earlier hours of collection, continue to besprinkle the capsules, and which here does a double mischief—first, by retarding the inspissation of the general mass of the juice; and, secondly, by separating its two most remarkable constituent parts—that which is soluble, and that which is insoluble in water. So little aware, or so reckless, even under the most favourable construction of their conduct, are the *koéris* of the injury thus caused by the dew, that many of them are in the habit of occasionally washing their scrapers with water, and of adding the washings to the collection of the morning: in Malwa, *oil* is used for this purpose, to the irremediable injury of the flavour of the opium. On examining the juice thus mixed with water, it will be found that it has separated, as above-mentioned, into two portions, a fluid and a more consistent; the latter containing the most of the resin, gluten, caoutchouc and other less soluble constituents of opium, with part of the super-meconiate of morphia; and the former containing the gum, some resin, and much of the super-meconiate of morphia, and much of the colouring principle, which, though pale at first, is rapidly affected by light, and acquires a very deep "reddish or blackish brown" colour. Many *koéris* are in the habit of draining off this fluid portion into a separate vessel, and of bringing it under the name of *paséwá*, for sale, at half the price of opium, to the Benares agency, where it is used as *léwa*, (paste for the petal envelopes of the cakes.) Others, after allowing the soluble principles to become thus changed into an acescent, blackened, sluggish fluid, mix it up with the more consistent part of their opium, and bring the whole for sale in this mixed state;

the consequence of which is that they are subjected to a penalty, called *battá upon paséwá*, and regulated by the estimate of the opium examiner, of the quantity of *paséwá* contained. This penalty is the only efficient check upon this most pernicious practice of the *koéris*: for on the generality of the *gomáshtas*, it is difficult to impress the necessity of their looking after the *koéris* during the collecting season. Were *gomáshtas* in general fit for their offices, the name of *peséwá* might be banished from the Bengal agencies; all that is required for that purpose being that they should instruct all their *mahtás* and *koéris*, to exclude dew as much as possible from the opium at collection—never to add water to their opium, then or at any other period; but at the end of their day's collection, to rub it together in a mortar or similar vessel, breaking down the *grain* of it above-mentioned, so as reduce the whole to a homogeneous semi-fluid mass, which should be dried as quickly as possible in the shade, in a current of air free from dust, by spreading it on any clean flat surface, and turning it over ten or twenty times. With this management, one afternoon in the dry collecting season would suffice for bringing to the spissitude of 70 per cent. the collection of each day, which could then be secured, along with the rest of the *koéris*' opium, in a vessel of *any* form, safe from deterioration by internal change. It is a common belief, that all new opium *must* ferment*: but that is a fallacy occasioned by the low degree of spissitude at which opium is generally received at the Bengal agencies, and by the consequent fermentation and swelling up which almost constantly occur, when such opium is allowed to stand for some hours in large vessels.

10. So very large was formerly the admixture of *paséwá* in the opium brought to the Benares agency, that it was thought necessary, for the sake of its appearance, to draw off as much as possible of the black fluid, by storing it, for weeks, in earthen vessels, perforated with a hole. Of late years, there has been a great amendment in this respect, and the draining system has therefore become unnecessary; an event which ought to be followed by the abolition of the inconvenient receptacles in which it was carried on, and by the general substitution of movable wooden cases and drawers in their stead.

11. *Paséwá*, in a pure and concentrated state, is a viscid, dark reddish-brown fluid, transparent in thin plates. Its homogeneous physical constitution prevents its assuming to the eye that appearance of consistency which is presented by ordinary opium. In the former, all

* Dr. ABEL believed that fermentation was necessary for the development of the narcotic principles, and considered the fermentation as of a panary species, in which the gluten played a principal part.

the ingredients are in a state of true chemical combination, with the water contained; while, in the latter, many of the ingredients are only in a state of mechanical mixture, a condition which almost necessarily gives an appearance of solidity beyond all proportion to the actual quantity of solid matter contained. Hence, *paséwá*, and opium containing *paséwá*, are less consistent, and would, to the inexperienced eye, appear to contain much more water than pure opium of the same actual spissitude; a source of much perplexity to any one who tries for the first time to estimate, by the consistence, the real spissitude or dry contents of different samples of opium containing more or less of *paséwá*. A tentative process is the only one by which a person can qualify himself to estimate the spissitude with tolerable accuracy. He should, before allowing the *parkhiyas* to state their estimates of the spissitude, form one in his own mind, and make a memorandum of it, noting his reasons for assigning the degree of spissitude on which he has fixed. The result of the steam-drying test, to which small samples of all opium are subjected in the Benares agency, will then enable him to judge on which side, whether under or over-estimate, he has inclined to err, and to avoid the error in his subsequent operations.

12. The constituents of *paséwá* are in a state of chemical combination; and the slow addition of water will not subvert that condition. But the sudden affusion of a large quantity of water on concentrated *paséwá* instantly resolves it into two portions, a dark coloured fluid containing the gum, colouring matter, and super-meconiate and acetate of morphia, and a lighter coloured powder, consisting of the resin and some gluten, and a minute portion of caoutchouc. In making *léwá*, therefore, from *paséwá*, or from inferior opium, the necessary quantity of water should be slowly added, and thoroughly mixed previously to the addition of more water. Pure opium is liable to the same resolution of its component parts, from the sudden affusion of water: if the latter be slowly added and thoroughly mixed, the gelatinous opium will absorb it, forming a species of hydrate, and will retain its tremulous consistence; but if the water be suddenly added in considerable quantity, an immediate separation of the more and less soluble constituents occurs, and the opium loses its gelatinous and adhesive character. When opium is dried up to a certain point, below the spissitude of 80 per cent., it loses the power of absorbing water without decomposition, and cannot be brought to the gelatinous state. It might be expected, that by adding 30 parts of water to 70 of dry opium powder, we should produce a combination possessing the consistence and other physical characters of fresh standard* opium; but

* So called, because this is the degree of spissitude required at the Bengal

the compound has little *consistence*, and will be found to contain insoluble portions, which have lost their power of forming hydrates with water: yet its *spissitude* remains exactly that of standard opium, the precise quantity of dry opium employed in making it being recoverable from it, but in a darkened and deteriorated condition. The above observations have a practical bearing upon the manufacture of *léwá*, as has already been noticed, and upon the degree of spissitude which opium, either in the hands of the *koéris* or in the agency godowns, should be permitted to acquire: it should be limited to 66 or 67 per cent. for the former, and 70 or 72 for the latter; because, with every additional degree of spissitude above this, the solubility is impaired in an increasing ratio.

13. Among some thoughts on the subject committed to writing six years ago, I find the following remark and query: "The whole of the original milky juice will pass through a finer filter than that used by the Chinese in making the extract for smoking: is it possible to dry the opium, retaining its property of such minute division and diffusibility; or is it necessary for the complete separation of the water from the resin, gluten, caoutchouc, &c. that *some* absorption of oxygen should take place, and some consequent diminution of their solubility, or rather miscibility with water?" My reason for noticing this query is the subsequent solution of the proposed problem by M. PREVITE of Calcutta, in the highly similar case of animal milk, which he appears to have succeeded in drying to a powder with no perceptible injury to the diffusibility of its curdy and oleaginous principles. This is the very result that should be aimed at in the preparation of opium for the China market.

14. When the juice of the poppy has been properly dried, that is, rapidly, in a cool shade, and protected from dust, it possesses, at the spissitude of 70 per cent., (that is, containing 30 per cent. of water,) the following properties. It has, in the mass, a "reddish brown" colour (*Werner*), resembling that of copper (the metallic lustre obstructed); and, when spread thin on a white plate, shews considerable translucency, with a "gallstone yellow" colour, and a *slightly* granular texture. When cut into flakes with a knife, it exhibits sharp edges, without drawing out into threads; and is tremulous, like jelly, or rather strawberry jam, to which it has been aptly compared. It has considerable adhesiveness, a handful of it not dropping from the hand inverted for some seconds. Its smell is the pure peculiar smell

agencies for the full price allowed by Government. On parcels of opium, inferior to this in spissitude, a penalty is levied, called *battá upon consistence*.

of opium, heavy and not unpleasant. In this condition it is said to be "standard" or "*awwal*" opium.

15. When the juice, again, instead of being thus exposed to the air, has after collection been kept in deep vessels, which prevent evaporation, it presents the following appearances. A specimen of it which has the spissitude of only 60 per cent. has the apparent consistence or substantiality of standard opium of 70 per cent. But on minuter examination, it will be found, that this apparent firmness of texture is a deception, resulting from the mechanical constitution of the mass; it being made up with but little alteration of the original *irregular drops* collected from the capsule, soft within, and more inspissated without; this outer portion, as long as it remains entire, giving the general character of consistency to the mass, just as the shells of a quantity of eggs would do. For when the opium is rubbed smartly in a mortar, this fictitious consistence disappears, exactly as that of the eggs, if pounded, would do; and in point of apparent consistence, as well as of real spissitude, it is reduced to the proportion which it properly bears to standard opium. When opium thus retains the original configuration of the irregular drops, it is said to be "*kachá*" or "*raw*:" when these are broken down into the *minute grain* mentioned in the description of standard opium, it is said to be "*pakka*" or "*matured*," whatever may be the actual spissitude of the opium, whether 50 or 70 per cent. An opinion has been entertained, but on what grounds I know not, that the breaking down of this large grain is an injury to the opium: to myself it seems plain that as the large grain *always* disappears before the opium attains the spissitude of 70 per cent. and as this vesicular constitution of the raw opium retards the evaporation of its superfluous moisture, the more inspissated shell of each irregular drop checking the evaporation from its more fluid interior, the object should be to reduce the whole with the least possible delay to a nearly homogeneous mass, in which state the inspissation of opium advances with much greater rapidity.

16. Connected with this subject is a question which has been raised, whether the inspissation of opium stored in large quantities in the agency godowns is effected more quickly, by removing, from time to time, into another receptacle, the pellicle of thick opium which forms on the surface of the mass; or by turning over the mass frequently, and thus constantly mingling with it the pellicles successively formed. As agreeably to the general law of chemical affinity, whereby the last portions of any substance held in combination, and in course of gradual expulsion, are retained with increasing obstinacy, the inspissation of thin, is, *ceteris paribus*, always more rapid in its pro-

gress than that of thick opium ; it is clear that the removal of the pellicle, by which opium of minimum spissitude is constantly exposed to the air, must accelerate the inspissation more than the turning over of the whole mass would do : because the latter process exposes to the air opium which is gradually acquiring a greater degree of concentration, and from which the evaporation will gradually be *slower and slower*. As evaporation takes place from the external surface only, it may be proper here to advert to the propriety of making all reservoirs for opium below the standard spissitude as numerous and shallow as may be permitted by the means of stowage ; every practicable method being at the same time adopted to facilitate ventilation across, and to exclude dust from, the extensive surfaces exposed ; and as little light being admitted as may be suitable to the convenience of the people at work.

17. It might be expected, from the ingenuity of the natives of this country, and from their imperfect notions of fair trade, that they would resort to a great variety of means for increasing, by adulteration, the weight of such an article as opium, in which fraud might be made so difficult of detection. But in fact, it is seldom that they attempt any thing of the kind, beyond keeping their opium at a low spissitude ; an act by which, under the present searching system of examination, they cannot profit ; and which, from its occasioning a deterioration of their opium through fermentation, entails the levying of a *batta* upon its quality, and therefore, in those cases, an inevitable loss. It is impossible that opium left to itself in the open air, during the parching season of the hot winds, could remain at the low spissitudes of 50 and 60 per cent. at which it is frequently brought to Gházípúr towards the end of that season : and we must therefore conclude, that artificial means are resorted to, in order to maintain it in that condition ; either the frequent addition of water, or the burying it in a damp piece of ground, which is said to be sometimes done for the sake of security. When these malpractices have been carried too far, the gluten undergoes, in a greater or less degree, the process of putrefaction ; the mass of opium first becoming covered with mould, and acquiring an opaque “yellowish grey” colour and a pasty consistence, in which every vestige of the translucency and *grain* of the opium is lost ; and the smell becoming venous, sour, and at last abominably foetid ; in which condition the deteriorated opium is fit for none of the purposes of the manufacture, and is always destroyed, and its original value forfeited, by the *koéris*. It is to be hoped that their experience of the unvarying consequences of such folly, and the introduction of a superior class of gomáshtás, will in time convince them of the advantage, as well as

the facility, of bringing in all their opium at very nearly the standard spissitude.

In some cases it would appear, from the fluid state in which they bring it for sale, as if they expected every drop of water which they add to it, to be assimilated and converted into opium. Occasionally, it would seem that they had admitted some suspicions of its having been watered too much; and their only remedy is to drive off the superfluous water by *boiling*: an operation which speedily reduces the mixture to a blackened and charred condition, easily recognized.

18. A more ingenious fraud, but which is seldom practised, is, that of *washing out* the soluble and most valuable part of the opium, and bringing for sale the residual mass. In this process, the opium loses its translucency, and the *redness* of its colour: it loses its adhesiveness also, not adhering to the hand like opium which has not been robbed of its soluble principles; and by these marks, without going further, the fraud is detected. *Sand* is now and then added, to increase the weight; and is at once detected by its grittiness when rubbed between a plate and a spatula.

Soft clayey mud is also, but very rarely, used for the same purpose: it always impairs the colour and translucency; and can, as well as sand, be detected, and its quantity accurately ascertained, by washing the opium with a large quantity of water, and collecting the sediment, which is the clayey mud.

Sugar and *gur*, or coarse molasses, are sometimes employed to adulterate opium: they invariably ferment, and give it a sickly, sweetish, venous, or acescent odour, easily known.

Cow-dung, the pulp of the *dhatúrú*, or thorn-apple, and the gummy resinous juice of the *bél*, or Bengal quince, are seldom met with as fraudulent ingredients: the first may be detected by drying it to a powder, or by washing it with water, either of which processes brings under the eye the undigested shreds of vegetable matter constituting the animal's food; but the two last are extremely difficult of detection, if not added in quantity sufficient to affect the colour and smell of the opium, which generally happens in the few instances of their occurrence. The seeds of the *dhatúrú* are apt to get mixed with the opium, and afford a ready means of detection. A strange, but not uncommon, mode of adulteration is the addition of *pounded poppy seeds*: if reduced to a fine powder, the oleaginous seeds might enter into an imperfect chemical union with the kindred resinoid principle of the opium: but the fraud is never so skilfully effected as to produce this result; and the hard particles of the seeds are perceptible to the touch and sight. *Málwa* opium, though less now than it was

eight years ago, is in general largely contaminated with oil, which is easily separated by dissolving the opium in water ; and I have seen, in a few instances, the same fraud attempted within the Benares agency. As the oil is always in a rancid condition, its presence is betrayed by its odour, as well as by the glistening appearance which it communicates to the opium.

19. By long exposure to the heat of the sun, the texture of opium, whatever be its spissitude, undergoes a remarkable change, through the conversion of part of its gluten into a species of bird-lime. Its *shortness* or property of exhibiting sharp edges, when cut into flakes with a knife, disappears ; and it draws out into long threads.

These two varieties of texture may almost always be recognized in cakes of Behár and Benares opium respectively ; the former being exposed to the sun, in the process of drying the cakes, and the latter not. This diversity of treatment occasions a difference between the hygrometric properties of the cakes of the two agencies ; the Behár cakes acquiring a more speedy but less permanent hardness than the Benares : whereby, though firmer in the shell towards the end of the hot winds, they are more liable than the Benares to soften and lose their shape during the rains. The immediate cause of this difference appears on making a clean section of the shells with a sharp knife. It will thus be found, that in the Benares shells, the *léwá* remains visibly interstratified with the petals, dark-coloured, and tenacious ; while in the Behár, it is in a great measure absorbed by the petals, which are apparently in intimate contact with each other, and is not to be distinguished from them ; the *combination* being more easily effected by hygrometric changes of the atmosphere than the *independent strata* of leaf and *léwá* in the Benares cakes.

20. While, as at present, a considerable amount of inferior opium is produced, not safely applicable to any other purpose than the manufacture of *léwá*, its sacrifice is no great loss. But if *all* the opium brought to the agencies were of good quality, the substitution of some less expensive vegetable paste would be an important desideratum. Any strong cheap mucilage or farinaceous paste, or perhaps some indigenous imitation of bird-lime, would answer for the inner portion of the shell ; and an exterior coating of a resinous, waxy, or oily nature, impervious to water, would defend this from the moisture of the air.

21. In cutting open a cake for examination, the above points should be attended to. It should also be observed whether the external and internal surfaces of the shell are smooth : the former not knotty or fissured, and none of the interior leaves of the latter detached among the opium : there ought, also, to be no vacuities between

the strata of the leaves, such as are sometimes found, lined with mould, in faulty cakes, and the shell altogether ought to be thin, compact, and of equal thickness throughout. The shape ought to be as nearly spherical as possible: that being the geometrical form which under the smallest surface contains the greatest quantity of matter, and which consequently affords the least scope for the extrication of air and ultimate injury to the shape of the cake when that air escapes. Greater attention to having the earthen cups, in which the cakes are dried, *perfectly* hemispherical, instead of parabolical as they now are, would contribute to the desired sphericity.

22. In opening a cake, the next thing to be attended to is the manner in which the two hemispheres of the opium separate: the Behár will be found to retain its *shortness*, while the Benares draws out into threads. The smell should then be attentively observed and noted down, being strongest immediately after the opening, and giving at that instant the fairest indications of the state of the opium with respect to preservation; the pure narcotic, venous, or acescent odour being then most strongly perceptible: in this respect the Benares will generally prove superior to the Behár. It is an important character; for the Chinese are great epicures in the flavour of opium, and object to it when it smells at all sour.

23. The surface of the opium should then be narrowly inspected, and the tint and shade of colour, both by reflected and transmitted light, noted down, in terms of Werner's nomenclature; also the apparent quantity of *paséwá* if any be present, which is almost constantly the case with Behár opium, where it appears like dark glistening fluid, lining the little cells in the surface of the opium. As the depth of the colour of opium in the caked state depends on the quantity of *paséwá* in it, or the degree in which it has been deteriorated by exposure to the sun, the lighter the shade, the better is the opium.

24. The chemical analysis of opium, after all the trouble that has been bestowed on it, is still in an unsatisfactory state. A perfect analysis, such as we possess of Peruvian bark, and of some other medicinal plants yielding vegetable alkalies, ought to eliminate the whole of the active principles, leaving nothing at its close but an inert mass possessed of no therapeutic power: and the essential principles thus obtained should equal (or, as in the case of quina freed from its bulky fibrous accompaniment, surpass) in activity, a quantity of the original substance equal to that from which it was extracted. But how greatly inferior are the powers, over the animal economy, of a grain of morphia, in whatever state of purity or saline combination, to the quantity of opium that is required to furnish that single grain! Yet, for all that

we can, chemically, see, we obtain by our analysis the whole of the morphia that is contained in opium. I suspect that the narcotic power is partly lodged in some unknown substance (not narcotine) insoluble in water : for I have, after careful and repeated washing, until it ceased to colour the water, found the insoluble residuum to act as an opiate with considerable energy. Although morphia, in a state of purity, can, like sulphur, be fused without change ; yet, when in combination with the other constituents of opium, it is partly destroyed by a much lower degree of heat, greatly under that of boiling water ; for the pharmaceutical and Chinese extracts are found to contain very little morphia : still, the former, as is well known, exert great medicinal power, out of all proportion to the quantity of morphia which analysis evolves from them. From all these considerations it would result, that the proportion of morphia obtained, by the analysis at present known, cannot be regarded as a true exponent of the total narcotic power of the opium which yields it. An additional source of fallacy in comparing the produce of different countries exists in the varying proportions which they contain of colouring matter or extraction ; a principle for which morphia and narcotine have a strong affinity, forming insoluble compounds* with it ; and which, as well as narcotine, is much more abundant in Indian than in Turkey opium. Hence a considerable loss in the purification of morphia from the former, and an apparent, and probably real, inferiority in its quantity ; although we know that good India opium is equal to Turkey in narcotic power.

25. **ROBIQUET'S** process is the one employed by the opium examiner in Calcutta. The chief precautions necessary to ensure success and uniformity in its results are, not to use too much water at first ; to see that the magnesia is brought to a red heat ; not to expose any of the subjects of analysis to the sun, or to artificial heat, except in the washing and final solution in alcohol of the morphia ; not to use too strong a spirit in washing the morphia and excess magnesia ; and to employ the strongest alcohol for its final solution before crystallization. **SERTUERNER'S** process is useful where it is not necessary to obtain the morphia in a separate state : and in practised hands affords speedy and tolerably accurate information. It is probable that **ROBIQUET'S** process will in time be superseded by that of the late **Dr. WILLIAM GREGORY** of Edinburgh, which does not acquire the expensive use of alcohol, and yields more morphia, by 30 or 40 per cent. ; affording, in fact, the cheapest medicinal preparation known of Turkey

* This may partly account for the medicinal activity of the mass of opium above noticed.

opium. It consists in the exhaustion of the opium with water under the temperature of 90° ; concentration of the solution at a low temperature; precipitation by slight excess of ammonia; elutriation of the precipitate with cold water; exsiccation of it at a temperature below 212° , and reduction to powder; solution in cold water by muriatic acid, slowly added in slight excess; filtration and concentration to the consistence of syrup; after which, the preparation on cooling, becomes a mass of crystals of muriate of morphia, moistened with a dark-coloured solution of uncrystallizable muriate of narcotine and resinoid colouring matter. This solution is abstracted from the crystals by strong pressure between folds of bibulous paper; and the solution, crystallization, and expression repeated once or twice; after which, the salt is obtained in radiated bunches of snow-white silky crystals, containing 37 parts of muriatic acid and 322 of morphia. But for the unfortunate super-abundance of narcotine, and comparative paucity of *obtainable* morphia, in Indian opium, the manufacture of the muriate on a large scale might advantageously be established, at one of the Bengal agencies, for the supply of the Indian medical department with this admirable preparation, the marc (?) of which would be available for the manufacture of *léwá*.

26. Connected with the subject of analysis is another which claims some attention from the opium examiner, the accuracy and sensibility of the weights and balances used in his department. Neither of them should ever be allowed to be soiled with opium; and the former should occasionally be compared, to see that all weights of similar denominations mutually correspond within one-tenth of a grain, and that the larger and smaller weights are equally accurate multiples and sub-multiples of each other. The knife-edges of the balances should occasionally be sharpened, so that they may turn with as little friction as possible; and the three points of suspension, whenever deranged, should be brought into a perfectly straight line, by bending the beam with the hand: if the centre edges be too low, the balance will, when loaded with its proper weights, be in a state of unstable equilibrium, and will cause great mistakes; and if they be too high, the balance will lose its sensibility, and cannot be depended upon within perhaps two grains. Care should also be taken that the distance from centre-edges to arm-edges are exactly equal; from accidental violence, this element of accuracy is very apt to be deranged, and causes great confusion when overlooked.

27. Were all the opium brought for sale unexceptionable in quality, free from *paséwá*, and liable to battá on account of deficient spissitude only, there would be, supposing the batta levied with tolerable accuracy, little difference at the end of the manufacturing season, between

the registered receipts and expenditure of opium: and, supposing it levied with *strict* accuracy, there would be a small loss, occasioned by accidental spilling of semi-fluid opium, adhesion to the persons and clothes of the work-people, and other unavoidable sources of wastage. But as, in the present state of things, *battá* to a considerable amount is levied on quality, the effect of its deduction, if not kept separate from the *battá* on spissitude, would be to shew, at the end of the year, a deceptive deficiency of receipt compared with expenditure. *Battá* upon quality, or *paséwá*, therefore, should not be admitted into the godown accounts; and should be confined to the account between the receiving-officer and the *koéri*.

28. There are no satisfactory experimental means, except perhaps by the specific gravity, of ascertaining the precise quantity of *paséwá* in opium. It will hardly drain at all from opium of higher spissitude than sixty per cent. and not readily from opium of even that spissitude, unless assisted by a slight fermentation, which greatly facilitates its flow: the *paséwá* trickling down the sides of the air-vesicles thus formed. The only convenient rule for the adjustment of *battá* upon *paséwá*, or upon quality generally, is, that absolute *paséwá*, if not too thin, and the worst opium purchased for the Company, being paid for at half the price of standard opium; for different grades of inferiority in quality between those two conditions, as fair a gradation of penalties shall be fixed, as can be formed from an estimate of the sensible qualities.

29. It has been thought, that specific gravity might prove an accurate index of the spissitude of opium; which is, however, not the case; its soluble principles, and that portion of its insoluble constituents which, slightly modified, unite with the soluble in forming *paséwá* acquiring in their transition to this altered state, a considerable increase of density. Opium, therefore, containing *paséwá*, is much heavier than an equal *bulk*, at the *same* spissitude, of pure opium. I have found this condensation to bear same proportion to the quantity of *paséwá* apparently contained: and it might, probably be found to indicate with considerable accuracy the proper amount of *battá* to be levied for *paséwá*, were such nicety desirable or conveniently attainable.

30. The Regulation of Government, which requires Civil Surgeons to report upon the relative values of parcels of confiscated opium, according to the quantity of foreign matter which they may contain, is obscure on two important points: 1st, whether, and beyond what degree of thinness, *water* is to be considered as foreign matter; and, secondly, whether and beyond what degree of deterioration,

fermented and *paséwá*, converted opium, when contained in the contraband article, are to be considered as "foreign matter." I have been in the habit of regarding them as foreign, when the water exceeded 30 per cent., and when inferiority in quality was palpable; because a different practice would defeat the end, for which the regulation was framed, of securing a fair reward to the informer. Under a less strict interpretation of the rule, he would be tempted to double the weight of the seized opium, and consequently his own reward, by adding to it, a sufficient quantity of water, or of bad opium, such as may at all times be clandestinely purchased for a trifle in the poppy districts.

IV.—*Catalogue of a Second Collection of Fossil Bones presented to the Asiatic Society's Museum by Colonel COLVIN.*

[Exhibited at the Meeting of the 6th April.]

Colonel COLVIN's first dispatch consisted of six large chests of fossil bones, in their rough state, attached to the matrix rock, as they were originally brought in from the hills by the native collectors employed by him to dig. They still remain unclassified in the museum, but the detailed examination that has been given to the second dispatch by Lieutenants DURAND and BAKER, whom experience has already made expert in recognizing fragments, even much mutilated, will materially assist in arranging the former specimens, while it leaves little to be done with the present beyond publishing their catalogue at once for the satisfaction of geologists, and preparing the specimens for the inspection of visitors. There are among them many noble fragments of known animals, which challenge comparison with those of any collection in Europe: these it will be a first object to make known by accurate drawings or by plaster casts. There are also numerous skulls, jaws, teeth, and bones decidedly new to fossil osteology, but the admirable fidelity and scientific knowledge with which the major part of these is now under illustration by Dr. HUGH FALCONER and Captain CAUTLEY, in the Asiatic Researches, from their own, even more extensive, cabinet, supplants the necessity of attempting a full investigation here. All points in which differences from their generic or specific descriptions are recognized, it will be the duty of our curator to bring to notice.

The synopsis published in the Journal for December last, page 706, comprised the varieties of organic remains, up to that period extracted from the upper deposits of the tertiary strata of the *Sivalik* or *Sub-Himálaya* range of hills. Most of the same are to be found in Colonel COLVIN's collection. Some recent additions of a highly interesting